improvements in diastolic and systolic function with pacing in the RVOT and at combined sites in the RV compared to RVA pacing. Thus asynchrony with prolongation of QRS is an important determinant of LV function.

## 998-71 Sensing of Mechanical Atrial Systole — A Novel Technique for VDD Pacing

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Single-lead VDD pacemakers are limited by inconsistent atrial sensing. In addition, the latency between electrical and mechanical atrial systole may be variable, making optimization of AV delay difficult. The purpose of the current study was to assess the feasibility of sensing mechanical atrial systole using a catheter-based piezoelectric crystal (XTAL). A quadripolar electrode catheter was modified by adding an XTAL ($7 \times 2$ mm) between poles 1 and 2. In 5 closed-chest dogs, the XTAL catheter was placed against the inferolateral wall of the right atrium. XTAL output (bandpass 1–25 Hz), right atrial (RA) pressure and RA electrograms (EGM) were recorded at baseline, during infusion of isoproterenol (1.5 μg/kg/min), during RA pacing, and after induction of complete AV block using radiofrequency catheter ablation. *Results:* Stable XTAL signals were recorded in all animals. Mean XTAL amplitude was 28 ± 20 mV in sinus rhythm (SR) and 15 ± 5 mV during RA pacing. There was no detectable "farfield" signal resulting from ventricular systole during any recording. There was less variability in the latency between the peak of the XTAL signal and the peak of the A wave than between the RAEGM and the A wave (8.2 ± 6.4 ms vs. 15.1 ± 6.8 ms, $p < 0.01$). Complete AV block did not affect the morphology or timing of the XTAL signal. *Conclusions:* A catheter-based XTAL placed against the lateral RA produces signals that are large in amplitude and correlate more closely with the peak of the A wave than the endocardial EGM. Further study of XTAL-based single-lead VDD pacing systems is warranted.

## 998-72 Serial Fluoroscopic Evaluation of the Telectronics Accufix™ 330–801 "J"-Shaped Atrial Pacing Lead

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A recall of the Telectronics Accufix™ 330–801 atrial lead was issued in November 1994, because of fracture of the "J"-shaped retention wire. To assess the integrity of the retention wire, we have performed fluoroscopic screening on 209 patients with the 330–801 atrial lead in place. Each retention wire was classified as normal, indeterminate, fractured without protrusion, and fractured with protrusion. Cine films of all 135 patients originally classified as normal were re-evaluated after the original screening. Eighty patients have undergone two serial fluoroscopic evaluations separated by 158 ± 5.4 days

Nine retention wires originally classified as normal were re-classified as fracture without protrusion, and two were re-classified as fracture with protrusion when the original films were re-evaluated. Eight of the 11 leads reclassified were screened during our first two days of fluoroscopic evaluation of this lead. Of the 80 patients who underwent a second fluoroscopic screening, 70 were initially classified as normal (nine of which were later re-classified as described above), one fractured, and nine indeterminate. There were no new fractures detected in this group; of the indeterminate group, four were reclassified as fractured after rescreening, three were classified as normal, and two remained indeterminate. The fractured retention wires in this group did not appear to change during this period.

We conclude that there is a definite learning curve associated with fluoroscopic evaluation of this lead, and recommend that screening be performed by cardiologists experienced in fluoroscopic screening. Fractured retention wires remained stable in appearance during this observation time, and no new retention wire fractures were detected.

## 998-73 Assessment of Pacing Lead Curvature and Strain With Three Dimensional Reconstruction of Biplane Cineangiographic Images in Vivo

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Pacing lead integrity is vital to pacemaker function and patient safety. Understanding the point of maximum strain on implanted pacing leads will help in lead design to minimize the occurrence of lead fracture. However, there has been no study on pacing lead strain in vivo. The dynamic position of newly implanted pacing leads were imaged with biplane cineangiography. The three dimensional (3D) description of the leads in each frame was determined by a triangulation technique previously developed in quantitative arteriography for determining stenosis or catheter location in space. Both atrial and ventricular leads were studied in each of 8 patients. To estimate strain in the lead wire insulation, the 3D curvature was calculated from geometric data using a seven point smoothing operation. The components of curvature were calculated at 23 ± 7 (range 11–31) frames. The curvature magnitude was computed from the components. *Results:* High localized areas of curvature were noted at 0 to 6 cm from the proximal electrode of the atrial lead, corresponding to the curvature of the J-loop. Significant components of curvature occurred in the anterior-posterior direction. The peak curvature of the atrial lead was 2.5 ± 0.5/cm, indicating a minimum radius of 4.1 ± 0.9 mm. Contrarily, the locations of the ventricular lead curvatures were scattered, compatible with the tricuspid movement. The peak curvature of the ventricular lead was 2.0 ± 0.6/cm, indicating a minimum radius of 5.6 ± 0.3 mm.

*Conclusions:* Using 3D reconstruction of lead position in space and a seven point smoothing operation for calculation of curvature, it is feasible to localize the areas of curvature and quantify the magnitude of curvature for pacing leads in vivo. The information derived from such analysis in large scale studies of acute and chronic leads should be important for improvement in the design of pacing leads to reduce the incidence of lead fracture.

## 998-74 Low Pacing Thresholds for Heart Wires Using a New Stimulation Technique

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OverLapping Biphasic (OLBI) stimulation of the heart is a new way of biphasic pacing by two pulses of different polarity. A significant threshold reduction has been reported in initial experiments.

*Methods:* External OLBI-stimulation was tested in 20 consecutive patients who underwent bypass or heart valve surgery before. Intraoperatively a bipolar heart wire (MHW 60-BP, BIOTRONIK) was fixed onto the right ventricle and a second (MHW 60-UP, BIOTRONIK) subcutaneous working as an indifferent electrode. Measurements of the threshold were performed up to the 8th postoperative day and were compared with thresholds ofconventional unipolar and bipolar stimulation at the same time.

*Results:*

| | Unipolar | Bipolar | OLBI |
|---|---|---|---|
| Day of surgery | 1.5 ± 0.6 V | 1.1 ± 0.4 V | 0.5 ± 0.1 V |
| 4th p.o. day | 6.8 ± 2.7 V | 4.3 ± 1.5 V | 1.9 ± 0.7 V |
| 8th p.o. day | >15 V** | 8.8 ± 4.7 V** | 3.5 ± 1.1 V |

**In 4 patients no effective unipolar and bipolar stimulation was possible at day 8 but for all patients by OLBI stimulation.

*Conclusion:* 1) OLBI-stimulation is effective and shows lower thresholds compared with conventional unipolar and bipolar stimulation. 2) The increase of pacing threshold is less pronounced for OLBI-stimulation. 3) Therefore effective cardiac stimulation is possible for a longer period and gives more safety, especially in therapy of patients with continued arrythmias postoperatively. 4) Using OLBI-stimulation irritation of the myocardial tissue caused by stimulation is reduced.

## 998-75 The Effect of Ventricular Pacing on Coronary Blood Flow

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Ventricular pacing is thought to produce the impairment of LV function by altering the sequence of ventricular activation and AV dyssynchrony. We hypothesized that ventricular pacing may produce deleterious effect on coronary blood flow (CBF). To test this hypothesis, we studied the effect of ventricular pacing on phasic coronary flow velocity (CFV), coronary arterial diameter (CAD) and coronary flow reserve (CFR) in 15 patients with normal coronary arteries. CFV, CAD and CFR in the left anterior descending coronary artery were measured using doppler flow wire during sinus rhythm, and during both atrial and ventricular pacing at a rate of 100 bpm in the same patient. Double product increased significantly during both pacing. CAD during ventricular (% increase: 16.4 ± 20.2%; $P < 0.001$) and atrial pacing (5.8 ± 10.1%; $P < 0.001$) significantly increased compared to that during sinus rhythm. APV during ventricular pacing (−18.9 ± 12.9%) significantly decreased compared to that during sinus rhythm ($P < 0.001$) and during atrial pacing (5.0 ± 19.9%; $P < 0.005$). CBF increased significantly during atrial pacing (34.9 ± 20.3%; $P < 0.001$), but not during ventricular pacing (24.5 ± 45.4%; P = NS). Since the hyperemic flow after the administration of papaverine was not different among them, CFR during both atrial (3.8 ± 1.3) and ventricular pacing (3.8 ± 0.9) decreased compared to that during sinus rhythm (4.5 ± 1.5). There was a significant positive correlation between CFR during sinus rhythm and the ratio of CBF during ventricular and atrial pacing ($R2 = 0.84$, $P < 0.001$). Also